51. IWK

Internationales Wissenschaftliches Kolloquium

International Scientific Colloquium

PROCEEDINGS 11-15 September 2006

FACULTY OF ELECTRICAL ENGINEERING AND INFORMATION SCIENCE

INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING - DEVICES AND SYSTEMS, MATERIALS AND TECHNOLOGIES FOR THE FUTURE

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=12391

TECHNISCHE UNIVERSITÄT
ILMENAU

Impressum

Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff

Redaktion: Referat Marketing und Studentische Angelegenheiten
Andrea Schneider

Fakultät für Elektrotechnik und Informationstechnik
Susanne Jakob
Dipl.-Ing. Helge Drumm

Redaktionsschluss: 07. Juli 2006

Technische Realisierung (CD-Rom-Ausgabe):
Institut für Medientechnik an der TU Ilmenau
Dipl.-Ing. Christian Weigel
Dipl.-Ing. Marco Albrecht
Dipl.-Ing. Helge Drumm

Technische Realisierung (Online-Ausgabe):
Universitätsbibliothek Ilmenau
ilmedia
Postfach 10 05 65
98684 Ilmenau

Verlag: isle
Verlag ISLE, Betriebsstätte des ISLE e.V.
Werner-von-Siemens-Str. 16
98693 Ilrnenau

ISBN (Druckausgabe): 3-938843-15-2
ISBN (CD-Rom-Ausgabe): 3-938843-16-0

Startseite / Index:
http://www.db-thueringen.de/servlets/DocumentServlet?id=12391

51st Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
September 11 – 15, 2006

B. Nikolić
S. Aleksić
Z. Cvetković

Influence of Fictitious Sources Type, Position and Number on Toroidal Grounding Electrode Conductivity Calculation

INTRODUCTION

The use of models of fictitious sources, located inside the electrode, has proved to be an efficient computational technique for calculating conductivity of grounding electrodes. The Method of fictitious sources (MFS), or Charge simulation method (CSM), is applied on toroidal electrode of circle cross section and also of ellipse cross section, for different ratios of semi-axes. This paper presents an analysis of influence of fictitious sources types on the precision of conductivity calculation, as well as of fictitious sources position and number. The estimation of Method of fictitious sorces is also been discussed.

BASIC APPROACH

The basic idea of Charge simulation method is to replace an actual electrode by fictitious sources, chosen in certain order and placed inside the electrode volume. The type, position and number of fictitious sources has a big influence on the accuracy and convergence. There are a few types of fictitious sources: point charges (for three dimensional systems), line charges with constant density per unit length (in the case of plan-parallel systems) and linear circular loops (for systems with axial symmetry). The geometry of fictitious sources can be more complex too, but that depends on the problem that has to be solved.

Besides the type of fictitious sources, their position and number influence on the conductivity calculation accuracy, too. Some geometries require the certain order and position of used fictitious sources.

The method of fictitious sources seems at first glance to avoid the disadvantages of both the differential and the integral method. However, a price is paid: there is no reliable general algorithm for chosing the position as well as the type of fictitious sources.

METHOD OF FICTITIOUS SOURCES APPLICATION

In studies of grounding conductivity the Method of fictitious sources, as an approximate one, is often very useful. In this paper, it has been applied to determine the grounding conductivity of toroidal electrodes: first, of the toroidal electrode of circle cross-section and then of the ellipse cross-section, but for different values of ratio of semi axes.

For the case of toroidal electrode of circle cross-section, linear circular loops are used as fictitious sources, [4]. The unknown intensities of sources currents can be determined using boundary condition that the electrode potential is uniform. After fitting an approximate potential value to the electrode real potential in a selected number of points on the electrode surface, a system of linear equations with fictitious sources currents as unknowns is formed. After solving that system, the unknown currents can be determined and necessary calculations can be performed in a standard way. The circle loops placed at the circle smaller than the cross-section give the better results than their placement at the cross-section axis.

In the case of toroidal electrode of ellipse cross-section, the ratio of semi-axes requires an appropriate type and position of the loops. The loops are circular and positioned at the ellipse smaller than the cross-section as long as there isn't a big difference between the axes. When one of them becomes so greater than the other one, the loops should be circles and put along the longer cross-section axis, in order to achieve better accuracy of grounding conductivity.

The number of loops also has the influence on the grounding conductivity calculation. If the number of fictitious sources is bigger, the values of grounding conductivity are better. But, if the number is so big, then potential curves don't have an expected shape.

References:

[1] D. M. Veličković, B. R. Nikolić: "Non-linear grounding design", 48. International Kolloquium, Information Technology and Electrical Engineering, Ilmenau, Germany, September, 22-25, 2003, pp. 393-394.

[2] H. Brauer: "Computation of electromagnetic fields using integral methods", International PhD - Seminar "Computation of Electromagnetic Field", Budva, Serbia and Montenegro, 23-28 September 2004, pp. 201-212.

[3] B. R. Nikolić, S. R. Aleksić, Z. Ž. Cvetković: "Toroidal grounding electrodes driven by high currents", VI International Power Systems Conference, November, 3-4, 2005, Timisoara, Romania, Proceedings, pp. 391-398.

[4] Z. Ž. Cvetković, D. M. Veličković: "The influence of the unit cell's conductor thickness on the homogenity of electrostatic field", Proceedings of Techical University, Čačak, Serbia and Montenegro, 1995, pp. 31-35.

Authors:

Bojana R. Nikolić
Slavoljub R. Aleksić
Zlata Ž. Cvetković
Faculty of Electrical Engineering, Aleksandra Medvedeva 14, P.O.B. 73
18000, Niš, Serbia&Montenegro
Phone: +381 18 529 423
Fax: +381 18 588 399
E-mail: bojananik@elfak.ni.ac.yu, as@ elfak.ni.ac.yu, zlata as@ elfak.ni.ac.yu